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09/644,390

(12) UK Patent Application (19) GB (11) 2 311 155 (13) A

(43) Date of A Publicati n 17.09.1997

(21) Application No 9705432.4

(22) Date of Filing 14.03.1997

(30) Priority Data
(31) 19610116 (32) 14.03.1996 (33) DE

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(51) INT CL^6
E05B 49/00 , B60R 25/00

(52) UK CL (Edition O)
G4H HRBS HRCS HTG H13D H14A H14D H14G H60
U1S S1820

(56) Documents Cited
GB 2119141 A

(58) Field of Search
UK CL (Edition O) G4H HRBS HTG
INT CL^6 B60R , E05B

(54) Anti-theft system for a motor vehicle

(57) In a portable transmitter, an item of code information is modulated with each of two different carrier frequencies. In a receiver, a single item of code information is demodulated by logic operation from all of the code signals which are received. If the item of code information agrees with an expected item of desired code information, a release signal is produced. As a result of the separate transmission in two different transmitting channels, the item of code information is transmitted redundantly, as a result of which the item of code information is still reliably received even if there is disturbance of a transmitting channel.

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FIG 1

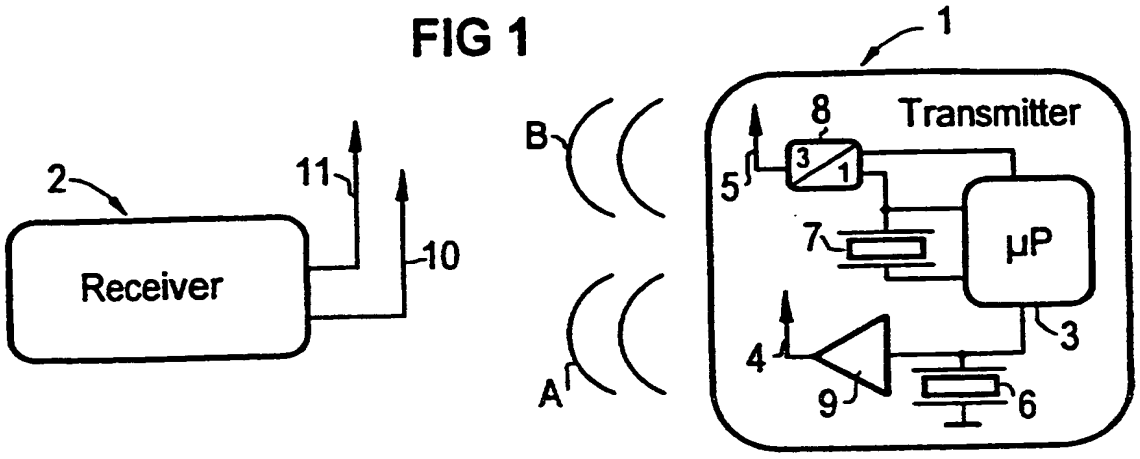


FIG 2

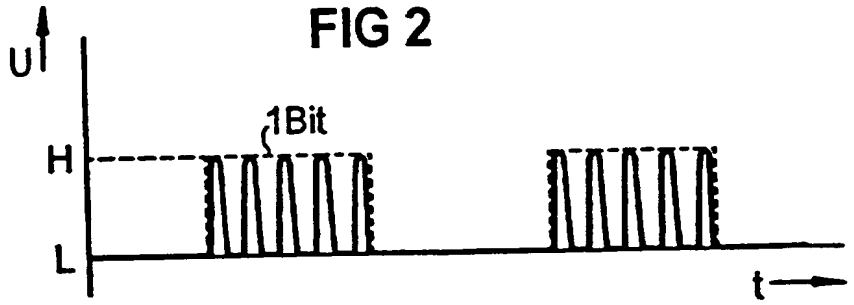


FIG 3

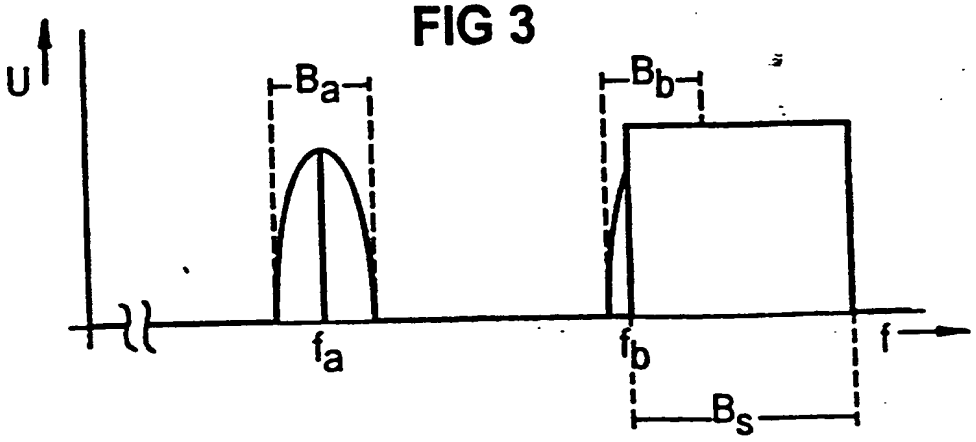


FIG 4

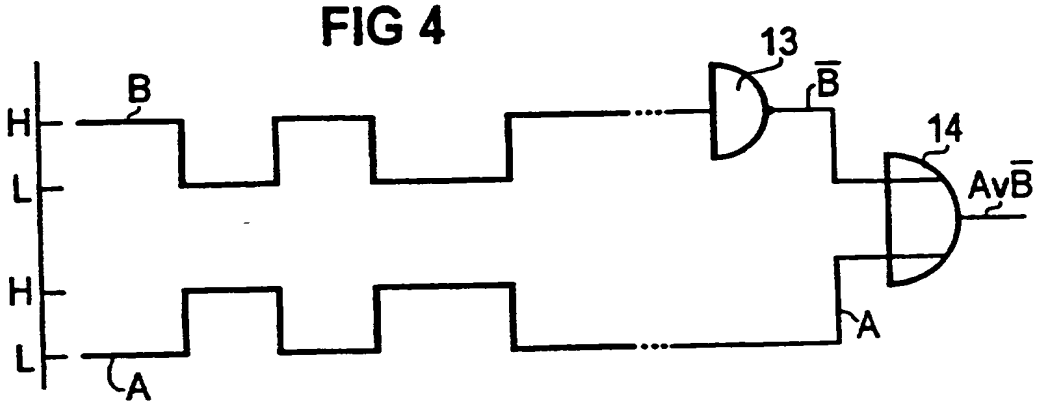
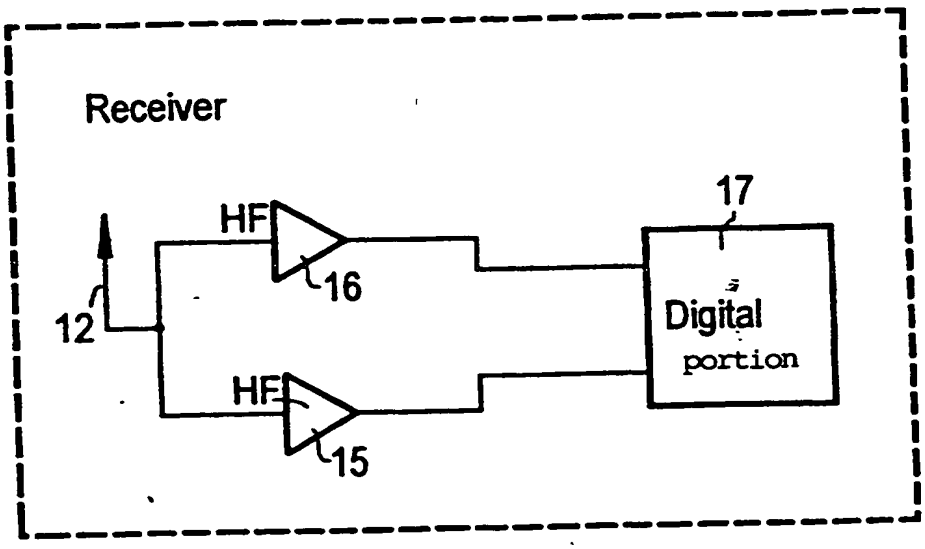


FIG 5



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ANTI-THEFT SYSTEM

The invention relates to an anti-theft system, and in particular to an anti-theft system for a motor vehicle.

A known anti-theft system for a motor vehicle (DE 43 29 697 C2) has a portable transmitter, which emits a modulated item of code information. Arranged in the motor vehicle is a receiver, which receives the item of code information, compares it with an item of desired code information and, in the event of agreement between the two items of code information, produces a release signal.

In order that such an anti-theft system functions reliably even in the event of disturbances, which are caused, for example, by a powerful jamming transmitter, the item of code information has to be transmitted again in another way, for example at an altered frequency. Disturbance of the transmission is therefore first established if first of all the expected code signal was not received.

The invention seeks to develop an anti-theft system, in particular for a motor vehicle, in which anti-theft system an item of code information is transmitted reliably even if transmission disturbances occur.

According to the present invention, there is provided an anti-theft system having:

a radio transmitter which converts an item of code information into at least two different frequency ranges with the aid of at least two different carrier frequencies, as a result of which at least two different code signals are produced, and which emits the code signals; and

a radio receiver, having a demodulator which demodulates the item of code information from the code signals which are received, compar s it with an item of

desired code information and, in the event of agreement between the two items of code information, produces a release signal.

In this connection, an item of code information stored in a portable transmitter is transmitted several times with different carrier frequencies as a code signal. A receiver in the motor vehicle reliably demodulates the item of code information from all of the code signals which are received.

Advantageous developments of the invention are set out in the subclaims.

For a better understanding of the present invention, and to show how it may be brought into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a block-circuit diagram of a first exemplary embodiment of an anti-theft system in accordance with the invention;

Figure 2 shows a time graph of an amplitude-modulated signal;

Figure 3 shows a frequency spectrum of transmitted code signals;

Figure 4 shows a block-circuit diagram of a part of a receiver of the anti-theft system according to Figure 1; and

Figure 5 shows a block-circuit diagram of a second exemplary embodiment of an anti-theft system.

In telecommunications, digital items of code information may be transmitted in a modulated manner with a carrier frequency. The frequency band for such transmissions that is permitted for motor vehicle uses is, practically worldwide, among others, between 433.05 MHz and 434.79 MHz. Because this frequency band is also used by amateur radio operators, whose permitted frequency band lies between 430 MHz and 440 MHz, and more and more new uses likewise cover this frequency

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band, the probability that the transmission of the item of code information from the hand-held transmitter to the motor vehicle will be disturbed by other transmitters is increasing.

In order that an anti-theft system for a motor vehicle functions reliably even in the event of disturbances, there is provided in accordance with the invention a portable transmitter (Figure 1), which has two transmitting stages. By way of these transmitting stages, two code signals are transmitted to a receiver 2 arranged in the motor vehicle. Contained in the code signals is an item of code information which is stored in the transmitter 1 and is extracted from the code signals and compared with an expected item of desired code information in the receiver 2. If both items of code information agree, a release signal is produced, by which the doors of the vehicle are locked or unlocked, or an immobiliser is activated or released.

The transmitter 1 has a modulator 3, which modulates the item of code information with two different carrier frequencies f_a and f_b. As a result of this, the item of code information is converted in each case into two different frequency bands (transmitting channels) and, as code signals A and B which are separate from each other, is emitted by way of transmitting antennae 4 and 5.

The carrier frequencies f_a and f_b can be produced by two different oscillators 6 and 7. Alternatively or additionally, a frequency multiplier 8 can also be arranged in a transmitting stage, while only an amplifier 9 is arranged in the other transmitting stage. Consequently, two different code signals are produced, which each contain the item of code information and are transmitted in the various transmitting channels to the receiver 2.

Two receiving antennae 10 and 11 of the receiver 2

receive the code signals and pass them on to a demodulator (not shown). The message content of the code signals (if there is no disturbance this corresponds to the item of code information) is demodulated there and passed on to an evaluation unit (not shown).

The item of code information is stored as a coded digital signal in a memory, for example in an E²PROM, of the transmitter 1, or is produced there with the aid of a mathematical algorithm. As a result of the modulation with a carrier frequency, an amplitude-modulated oscillation is produced, as shown partly in Figure 2.

Digital signals in binary form have the values 0 and 1 with the levels L (low) and H (high). In order to transmit these digital signals, a high-frequency carrier oscillation is amplitude-modulated. In this connection, the high-frequency carrier oscillation is switched on and off in the rhythm of the digital signal (see Figure 2).

In the present exemplary embodiment, the digital signal (= item of code information) is amplitude-modulated with the carrier frequencies f_a and f_b at two different carrier oscillations. As a result of this, there result in accordance with the frequency spectrum in Figure 3, two transmitting channels having the band widths B_a and B_b respectively, by way of which the code signals A and B respectively are transmitted.

It is assumed, in accordance with Figure 3, that a powerful jamming transmitter having a band width B_s happens to be present, the transmitting channel of which lies in the vicinity of the second transmitting channel having the carrier frequency f_b. As a result of the large band width B_s, the code signal B is indeed superimposed by the jamming transmitter and thus disturbed, so that this code signal B cannot be

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received completely. On the other hand, the code signal A is received completely and correctly, because this random jamming transmitter here acts only on the code signal B. The further the two carrier frequencies f_a and f_b are from each other, the less likely it is that both code signals A and B will be influenced by jamming transmitters having a limited band width B_s. As a result of this, a successful transmission of the item of code information is more likely.

Since the item of code information is contained in each code signal, the item of code information is transmitted several times and consequently completely redundantly. In order that the two code signals do not disturb each other (so-called intermodulation disturbances), one of the two code signals, and consequently the item of code information, is transmitted in a manner such that it is inverted or negated (see Figure 4). If the level of the code information is H, the respective transmitting stage is active, and if the level is L, the transmitting stage is inactive (see also Figure 2). As a result of this, the transmitting stages are then not active at the same time, as a result of which energy is saved for the transmission of the item of code information, because the transmitting stages, due to the redundant code information transmission, do not have to be continuously active, as would be the case, for example, with frequency-modulated code signals. In the case of frequency-modulated code signals, the transmitting stages would always be active and therefore more susceptible to frequency disturbances.

The inverted item of code information has to be inverted or negated again on the receiver side by an inverter 13, in order that it is again present in its original form. If the items of code information A and $\overline{B}$ are now supplied to an OR element, an item of code

information, being $A \vee \overline{B}$, is in each case obtained from all of the code signals which are received, even if disturbances arise in both code signals, although time-displaced with respect to each other. If the disturbances are present at the same time in all of the code signals, the item of code information is, however, not received correctly and completely.

For the comparison with the item of desired code information, it does not matter whether the code signal A or B is inverted after being received. If the code signal which was not inverted on the transmission side is inverted, the item of code information is also present in inverted form at the output of the OR element 14. If, on the other hand, the received code signal which was already inverted on the transmission side is inverted, the item of code information is present in non-inverted form at the output of the OR element 14.

The transmitter 1 and the receiver 2 can - as shown in Figure 1 - each have two transmitting antennae 4 and 5 or receiving antennae 10 and 11 or even - as shown in Figure 5 - only one single transmitting antenna and one single receiving antenna 12. If there is only one transmitting antenna and one receiving antenna 12, the signal which is received or is to be transmitted is divided into two HF-branches 15 and 16 (each a branch 15, 16 for a transmitting channel), which are connected to a digital portion 17. In the digital portions, the signal which is to be transmitted is modulated or the signal which is received is demodulated and also evaluated.

Figure 5 shows only the receiver 2. The same structure also applies in principle for a transmitter, with the difference that the signals in the HF-branches of a transmitter are transmitted in the opposite direction, i.e. from the digital portion to the

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antenna.

Due to legal regulations and optimal exploitation of the frequency band, it is advantageous if the items of code information are transmitted once in a manner such that they are inverted and once in a manner such that they are not inverted. Otherwise, this would lead to too great an increase in the band width of the code signals which are transmitted and a high utilisation of the frequency band. For this reason, a pulse of the item of code information of the transmitting channel B is transmitted in an interpulse period of the item of code information of the transmitting channel A. As a result of the different carrier frequencies f_a and f_b, the received code signals are allocated to the respective HF-branch.

The code signals have to be transmitted substantially at the same time. The start and duration of the code signals may then deviate from each other only slightly (within a predetermined tolerance width). As a result of this, the received code signals can be directly connected to each other in the receiver 2, i.e. without additional delay elements in an HF-branch, by the OR element 14, in order that a single item of code information is obtained.

The demodulated item of code information which is present at the output of the OR element 14 is compared with an expected item of desired code information which is stored in the receiver 2. If the two items of code information agree, a release signal is produced. The release signal can be used to release an immobiliser, to lock or unlock door locks, to switch a theft warning system on or off and/or to close or open windows and also the sun-roof of the motor vehicle.

The transmitter 1 can be arranged both on a conventional door lock or ignition lock and on other means, such as a cheque-card-size card. For the

invention, however, it does not matter where the transmitter 1 is arranged. It is essential that at least two different code signals A and B with at least two different carrier frequencies f_a and f_b are emitted by the transmitter 1. Each transmitted code signal contains the item of code information. Obtained from the received code signals is a single item of code information, which is compared with the item of desired code information.

In the case of the amplitude modulation or the so-called ASK-modulation (amplitude shift keying), there can also be present in the interpulse periods (see Figure 2) of the item of code information a measurable amplitude of the high-frequency carrier oscillation. The envelope curve of the modulated signal then represents the item of code information. However, each transmitting stage is then continuously active, which means an increased energy requirement.

In accordance with the invention, the item of code information is converted into at least two frequency ranges. It can also be converted into a plurality of frequency ranges and transmitted in parallel, as a result of which, however, the energy requirement increases.

In the transmitter 1 and in the receiver 2, microprocessors or functionally equivalent components can be used in each case in order to produce the code signals and to demodulate the item of code information again therefrom. The oscillators 6, 7 can be constructed as SAW-oscillators.

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Claims

1. An anti-theft system having:

a radio transmitter which converts an item of code information into at least two different frequency ranges with the aid of at least two different carrier frequencies, as a result of which at least two different code signals are produced, and which emits the code signals; and

a radio receiver, having a demodulator which demodulates the item of code information from the code signals which are received, compares it with an item of desired code information and, in the event of agreement between the two items of code information, produces a release signal.

2. An anti-theft system according to claim 1, wherein the radio transmitter has an inverter which inverts the item of code information and transmits it as a first code signal, while the non-inverted item of code information is transmitted as a second code signal.

3. An anti-theft system according to claim 1 or 2 wherein the radio receiver has an inverter, to which is supplied an item of code information which is demodulated from the code signals which are received.

4. An anti-theft system according to claim 3, wherein the radio receiver has an OR element, to which is supplied at least one inverted and one non-inverted item of code information, so that at the output of the OR element there is a single item of code information, which is compared with the item of desired code information.

5. An anti-theft system according to any preceeding claim, wherein the radio transmitter has a transmitting antenna and at least two transmitting stages, by way of which the code signals are emitted.

6. An anti-theft system according to any

preceeding claim, wherein the radio receiver has a receiving antenna and at least two receiving stages, by which the code signals are received and passed on to a demodulator (17) depending on their carrier frequency.

7. An anti-theft system as claimed in any preceding claim, for a motor vehicle.

8. An anti-theft system as claimed in claim 7, wherein the radio transmitter is portable, and the radio receiver is arranged in the motor vehicle, for receiving the code signals.

9. Anti-theft system according to claim 7 or 8, wherein the release signal is used to release an immobiliser, to lock or unlock door locks, to switch a theft warning system on or off, or to open or close windows or the sun-roof of the motor vehicle.

10. An anti-theft system substantially as herein described, with reference to the accompanying drawings.

11. A motor vehicle, including an anti-theft system as claimed in any preceding claim.

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The Patent Office

Application No: GB 9705432.4
Claims searched: 1-11

Examiner: Mike Davis
Date of search: 22 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4H (HRBS, HTG)

Int Cl (Ed.6): E05B, B60R

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2119141 A (MASTIFF)	1 at least

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